ELSEVIER

The Journal of Heart and Lung Transplantation

http://www.jhltonline.org

Health literacy in heart transplantation: Prevalence, correlates and associations with health behaviors—Findings from the international BRIGHT study

Maan Isabella Cajita, BSN, RN-BC,[a] Kris Denhaerynck, PhD, RN,[b] Fabienne Dobbels, PhD, MSc,[c] Lut Berben, PhD, RN,[b] Cynthia L. Russell, PhD, RN,[d] Patricia M. Davidson, PhD, RN,[a] Sabina De Geest, PhD, RN[b,c] and on behalf of the BRIGHT study team[1]

From the [a]School of Nursing, Johns Hopkins University, Baltimore, Maryland, USA; [b]Institute of Nursing Science, Department of Public Health, University of Basel, Basel, Switzerland; [c]Academic Center for Nursing and Midwifery, Department of Public Health and Primary Care, KU Leuven, Leuven, Belgium; and the [d]School of Nursing and Health Studies, University of Missouri-Kansas City, Kansas City, Missouri, USA.

KEYWORDS:
health behaviors;
health literacy;
heart transplantation;
physical activity;
survey;
multicenter

BACKGROUND: Health literacy (HL) is a major determinant of health outcomes; however, there are few studies exploring the role of HL among heart transplant recipients. The objectives of this study were to: (1) explore and compare the prevalence of inadequate HL among heart transplant recipients internationally; (2) determine the correlates of HL; and (3) assess the relationship between HL and health-related behaviors.
METHODS: A secondary analysis was conducted using data of the 1,365 adult patients from the BRIGHT study, an international multicenter, cross-sectional study that surveyed heart transplant recipients across 11 countries and 4 continents. Using the Subjective Health Literacy Screener, inadequate HL was operationalized as being confident in filling out medical forms none/a little/some of the time (HL score of 0 to 2). Correlates of HL were determined using backward stepwise logistic regression. The relationship between HL and the health-related behaviors were examined using hierarchical logistic regression.
RESULTS: Overall, 33.1% of the heart transplant recipients had inadequate HL. Lower education level (adjusted odds ratio [AOR] 0.24, $p < 0.001$), unemployment (AOR 0.69, $p = 0.012$) and country (residing in Brazil, AOR 0.25, $p < 0.001$) were shown to be associated with inadequate HL. Heart transplant recipients with adequate HL had higher odds of engaging in sufficient physical activity (AOR 1.6, $p = 0.016$). HL was not significantly associated with the other health behaviors.
CONCLUSIONS: Clinicians should recognize that almost one third of heart transplant participants have inadequate health literacy. Furthermore, they should adopt communication strategies that could mitigate the potential negative impact of inadequate HL.
J Heart Lung Transplant 2017;36:272–279

Health literacy (HL) is widely recognized among experts as an important determinant of health-related behaviors and health outcomes.[1,2] HL is commonly defined as the "degree to which individuals have the capacity to obtain, process,

See Related Editorial, page 253

[1]See Appendix for a listing of the BRIGHT study team participants.

Reprint requests: Sabina De Geest, PhD, RN, Institute of Nursing Science, Department Public Health, University of Basel, Bernoullistrasse 28, CH-4056 Basel, Switzerland. Telephone: +41-61-267-09-51. Fax: +41-61-267-09-55.
E-mail address: sabina.degeest@unibas.ch

1053-2498/$ - see front matter
http://dx.doi.org/10.1016/j.healun.2016.08.024

and understand basic health information and services needed to make appropriate health decisions."[3] People with inadequate HL tend to have difficulties processing and applying information related to disease management, such as understanding medication labels,[4] following discharge instructions,[5,6] and participating in patient–provider communication,[7] often resulting in poorer disease management[8] and, consequently, in poorer health outcomes.[1]

Compared with chronic diseases, such as heart failure, chronic kidney disease and diabetes, HL has been explored to a much lesser extent in organ transplantation and studies have not compared HL internationally.[9–15] Moreover, there are factors that are likely unique to the organ transplant process, particularly the severity of disease and complexity of treatment. In kidney transplantation, it has been reported that 5%[14] to 41%[11] of patients have inadequate HL. To date, no studies have explored the prevalence of inadequate HL, its correlates, and its association with health behaviors in the heart transplant population.

Using the Paasche-Orlow and Wolf and Health Outcomes Framework[16] as a guide, the objectives of this study were to: (1) explore and compare the prevalence of inadequate HL among heart transplant recipients internationally; (2) determine the correlates of HL; and (3) examine the relationship between HL and health-related behaviors (level of physical activity, smoking status, alcohol use, adherence to diet and sun protection behavior).

Methods

Sample

This secondary analysis used data drawn from the Building Research Initiative Group: Chronic Illness Management and Adherence in Transplantation (BRIGHT) study. The international cross-sectional BRIGHT study surveyed heart transplant recipients, outpatient clinicians and center directors from 36 heart transplant centers in 11 countries to examine multilevel factors related to immunosuppressive medication non-adherence.[17] Data were collected between March 2012 and October 2015. For this secondary analysis, only data from the 1,398 heart transplant recipients were used. Furthermore, 33 participants (2.4%) had missing HL data; hence, the final analyses only included data from 1,365 participants. Detailed information on the BRIGHT study has been reported elsewhere.[17] Briefly, the BRIGHT study utilized a multistage sampling approach. A convenience sample of countries and heart transplant centers was recruited, and then randomized samples of heart transplant recipients and clinicians were recruited from these centers.[17]

Variables

Health literacy

HL was measured using the single-item variant of the Subjective Health Literacy Screener (SHLS).[18] In a self-administered survey, participants were asked how confident they were in filling out medical forms by themselves on a 5-point Likert scale (choices: none/a little/some/most/all of the time). Inadequate HL was operationalized as being confident in filling out medical forms none/a little/some of the time (HL score of 0 to 2).[18] The SHLS developers recommended this threshold because it optimized both sensitivity and specificity.[18] The SHLS has been previously validated using the 2 most commonly employed HL measures, the Short Test of Functional Health Literacy in Adults (concurrent validity, $r_s = 0.33$, $p < 0.001$) and the Rapid Estimate of Adult Literacy in Medicine (concurrent validity, $r_s = 0.26$, $p < 0.001$), as reference standards.[18,19]

Health behaviors

The 2-item Brief Physical Activity Assessment Tool was used to measure physical activity level (inter-rater reliability, $\kappa = 0.53$, 95% confidence interval [CI] 0.33 to 0.72).[20] Sufficient physical activity was defined as engaging in 20 minutes of vigorous physical activity ≥ 3 times/week or 30 minutes of moderate physical activity ≥ 5 times/week.[20] Smoking status was measured using 1 item from the Swiss Health Survey.[21] Participants were asked whether they smoke and the responses were then dichotomized (current smoker or never smoked/quit smoking). Alcohol use was measured by asking the participants how many servings of alcoholic drinks they consumed in a typical week. The participants were then classified as being "non- or mild drinkers" (< 1 drink/day for females and < 2 drinks/day for males) or "moderate or heavy drinkers" (1 or > 1 drinks/day for females and 2 or > 2 drinks/day for males).[17] Dietary adherence was measured by asking the participants if they were advised to follow a specific diet in the past year and, if so, how strictly they followed the recommended diet on a 5-point Likert scale (choices: never/rarely/sometimes/often/ always). Participants were classified as adherent if they followed their recommended diets often/always. Finally, sun protection behavior was measured using 4 items from the Swiss Childhood Cancer Registry survey.[17] Participants were classified as adherent if they used sun protection most/all of the time or if they used sunscreen with a sun protection factor (SPF) of > 40.[17]

Correlates

Demographic variables included in the analysis were: age; gender; race; language spoken; educational attainment (participants were asked what levels of schooling they have attended; participants were then categorized into primary/secondary/university based on their highest educational attainment); employment status (participants were asked what percentage they work; participants were then categorized into unemployed if they worked 0% of the time and employed if they work more than 0% of the time); and country of residence. In addition, healthcare provider advice (whether the participant received advice from their healthcare provider regarding the health-related behavior) and comorbidities (current heart failure, para/hemiplegia, chronic obstructive pulmonary disease [COPD], depressive symptoms) were used as covariates in the analysis of the relationship between HL and physical activity. These covariates were chosen given their potential impact on a

person's functional ability (heart failure, para/hemiplegia, COPD) or motivation to engage in physical activity (depressive symptoms).

Statistical analyses

Data were analyzed using STATA, version 13 (StataCorp, College Station, TX). Descriptive statistics of the participant sociodemographic characteristics and HL were calculated as appropriate. The chi-square test was used to compare the percentages of inadequate HL per country. Backward stepwise regression was performed to determine the correlates of HL. Before performing the stepwise regression, we checked for multicollinearity using variance inflation factors. Language spoken and country of residence were highly correlated, so we removed language spoken before running the stepwise regression. It should also be noted that 3.2% of the observations had data that were missing completely at random; thus, complete-case analysis was performed for the remaining 1,321 observations.

Simple logistic regressions were first performed to examine the relationships between HL and the health-related behaviors. Hierarchical logistic regression was then performed to control for possible confounders for relationships that were statistically significant (HL and physical activity and alcohol use). It should be noted that 8.6% of the observations had data that were missing completely at random. These observations were dropped for the hierarchical logistic regression analysis. Finally, to check the robustness of our findings, 1-way sensitivity analysis was performed, wherein the cut-off score for inadequate HL was increased and decreased by 1 point.

Table 1 Participants' Characteristics

Variable	Number (%)[a]
Age ($N = 1,379$)	53.5 ± 13 (range 18.3 to 80.8) years
Gender ($N = 1,360$)	
Male	987 (72.6)
Female	373 (27.4)
Race/ethnicity ($N = 1,351$)	
Caucasian	1,165 (86.2)
Black	76 (5.6)
Asian	27 (2.0)
Hispanic	27 (2.0)
Other	56 (4.2)
Educational attainment ($N = 1,348$)	
Primary school	185 (13.7)
Secondary school	417 (31.0)
University	746 (55.3)
Employment status ($N = 1,361$)	
Employed	404 (29.7)
Unemployed	957 (70.3)
Country ($N = 1,365$)	
Europe	
Belgium	73 (5.4)
France	156 (11.4)
Germany	64 (4.7)
Italy	109 (8.0)
Spain	223 (16.3)
Switzerland	46 (3.4)
UK	99 (7.2)
North America	
Canada	115 (8.4)
USA	332 (24.3)
South America	
Brazil	98 (7.2)
Australia	50 (3.7)

[a]Excluding age.

Results

Data from 1,365 heart transplant recipients from 36 transplant centers across 11 countries and 4 continents were analyzed. Characteristics of the participants are shown in Table 1. The mean age of the participants was 53.5 ± 13 years, 72.6% were male, 86.2% were Caucasian, 55.3% had some post-secondary education, and 70.3% were currently unemployed. On average, the participants were 3.4 ± 1.4 (range 0.7 to 7.1) years after heart transplant at the time of data collection.

Overall, 33.1% of the heart transplant recipients had inadequate HL. Figure 1 shows the prevalence of inadequate HL across the 11 countries included in the BRIGHT study. There was significant variability in the prevalence of inadequate HL, with the rates ranging from 24.7% in the USA to 63.3% in Brazil.

A backward stepwise regression resulted in a 3-predictor model, which included educational attainment, employment status and country of residence as correlates of HL (Table 2). Heart transplant recipients who only had primary education had a 76% lower odds of having adequate HL compared with their counterparts who had some post-secondary education (95% CI 0.16 to 0.36, $p < 0.001$). Similarly, those with secondary education were 42% less likely to have adequate HL compared with their college-educated peers (95% CI 0.44 to 0.78, $p < 0.001$). Employment status was also significantly associated with HL. Heart transplant recipients who were currently unemployed had 31% lower odds of having adequate HL compared with those who were employed (95% CI 0.51 to 0.92, $p = 0.012$). Finally, the country in which the heart transplant recipient resided was also found to be significantly associated with HL, with those living in Brazil having 75% lower odds of having adequate HL compared with those living in the USA (95% CI 0.14 to 0.44, $p < 0.001$).

A hierarchical logistic regression analysis (Table 3) showed that HL was associated with physical activity even after controlling for age, gender, race, education and employment status (Block 1); country of residence (Block 2); comorbid conditions (Block 3); and receipt of care provider advice (Block 4). In particular, heart transplant recipients with adequate HL had higher odds of engaging in sufficient physical activity (adjusted odds ratio [AOR] 1.6, $p = 0.016$) compared to those with inadequate HL. Finally,

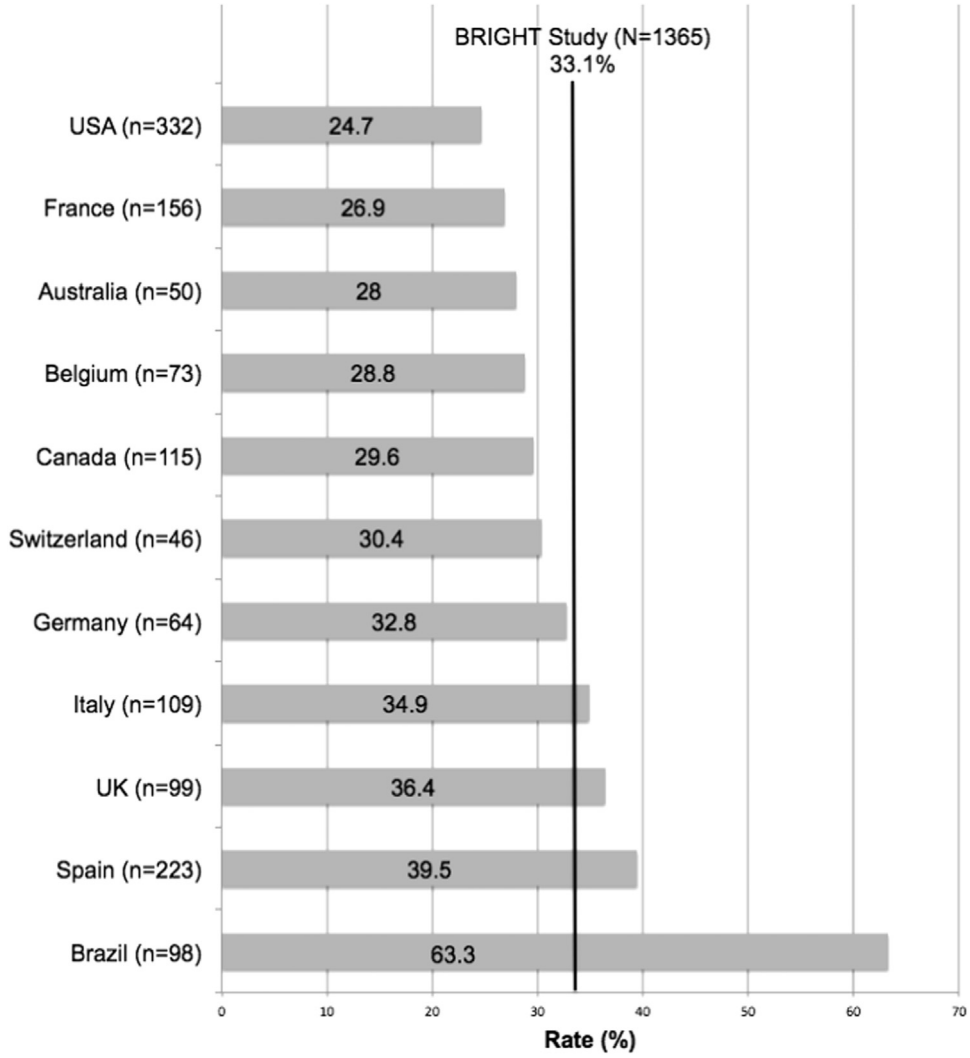

Figure 1 Variability in the prevalence of inadequate health literacy* across the 11 countries in the BRIGHT Study.*Health literacy (HL) – the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions. Measured using the 1-item Subjective Health Literacy Screener; wherein inadequate HL was operationalized as being confident in filling out medical forms none to some of the time. Inadequate HL was operationalized as being confident in filling out medical forms none/a little/some of the time (HL score of 0-2).

HL was not significantly associated with the other health-related behaviors (smoking status, alcohol use, adherence to diet, sun protection behavior).

Discussion

We found significant variability in inadequate HL rates across countries. In addition, educational level, employment status and country of residence were significantly associated with HL. Finally, adequate HL was significantly associated with sufficient level of physical activity.

The overall prevalence of inadequate HL among heart transplant recipients was 33.1%, which is considerably higher than what was reported in 2 multiple-country studies exploring HL in otherwise healthy populations. In the study by Sorensen et al, the prevalence of insufficient HL in the general population in 8 European countries was 12%.[22] In the study by Lupattelli et al, which surveyed pregnant women from 18 countries, the prevalence of inadequate HL was only 5.2%.[23] In addition, significant variability was observed in the prevalence of inadequate HL across the 11 countries. The prevalence of inadequate HL ranged from 24.7% in the USA to 63.3% in Brazil. This variability could be a reflection of the varying access to heart transplantation in these countries. In countries such as the USA, which do not provide government funding to cover the cost of heart transplantation, the substantial financial cost associated with organ transplantation is a major barrier, particularly for patients who do not have the financial means to pay for the transplant and the associated post-transplant care.[24] Given that HL and income are highly correlated,[25,26] we posit that the lower prevalence of inadequate HL among heart transplant recipients in the USA could be the result of the limited access to transplantation for people from lower socioeconomic strata. In addition, 2 USA-based studies that explored the role of HL in kidney transplantation found that those with inadequate HL were less likely to be referred for transplant evaluation[15] and were less likely to be added to the transplant list.[9] Conversely, Brazil has a publically funded transplant program that covers the cost of the

Table 2 Correlates of Health Literacy

	Unadjusted		Adjusted	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age	0.99 (0.98 to 1.00)	0.043	0.99 (0.98 to 1.00)	0.262
Gender				
Male	Reference group		Reference group	
Female	1.06 (0.82 to 1.37)	0.659	1.08 (0.82 to 1.43)	0.575
Race/ethnicity				
Caucasian	Reference group		Reference group	
Black	0.74 (0.46 to 1.19)	0.214	0.68 (0.39 to 1.18)	0.173
Asian	0.96 (0.43 to 2.17)	0.930	0.68 (0.28 to 1.62)	0.386
Hispanic	0.70 (0.32 to 1.53)	0.371	0.66 (0.28 to 1.55)	0.338
Other	1.02 (0.57 to 1.81)	0.952	1.29 (0.66 to 2.54)	0.461
Educational attainment[a]				
Primary	Reference group		Reference group	
Secondary	2.37 (1.67 to 3.38)	<0.001	2.44 (1.61 to 3.68)	<0.001
University	4.51 (3.22 to 6.32)	<0.001	4.18 (2.74 to 6.38)	<0.001
Employment status[a]				
Unemployed	Reference group		Reference group	
Employed	1.81 (1.39 to 2.35)	<0.001	1.45 (1.09 to 1.96)	0.012
Country[a]				
Belgium	Reference group		Reference group	
France	1.10 (0.59 to 2.03)	0.771	1.00 (0.53 to 1.90)	0.998
Germany	0.82 (0.40 to 1.71)	0.609	0.71 (0.33 to 1.51)	0.368
Italy	0.75 (0.40 to 1.43)	0.390	1.15 (0.58 to 2.26)	0.690
Spain	0.62 (0.35 to 1.10)	0.102	1.16 (0.62 to 2.17)	0.636
Switzerland	0.92 (0.41 to 2.07)	0.846	0.71 (0.31 to 1.66)	0.435
UK	0.71 (0.37 to 1.36)	0.296	0.58 (0.30 to 1.14)	0.113
Canada	0.96 (0.50 to 1.84)	0.907	0.80 (0.41 to 1.57)	0.510
USA	1.23 (0.70 to 2.17)	0.470	1.05 (0.58 to 1.92)	0.869
Brazil	0.23 (0.12 to 0.45)	<0.001	0.26 (0.13 to 0.53)	<0.001
Australia	1.04 (0.48 to 2.31)	0.926	0.74 (0.31 to 1.78)	0.502

[a]Correlates selected using backward stepwise logistic regression.

transplant procedure and post-transplant care, including a lifetime supply of immunosuppressive medications.[27] This lack of financial barrier to transplantation in Brazil could help explain the high prevalence of inadequate HL among its heart transplant recipients. Similarly, in Italy, Spain and the UK, organ transplantation and its related costs are also mostly covered by their healthcare systems,[24] which could account for the higher-than-average prevalence of inadequate HL among their heart transplant recipients. Besides the differing access to transplantation, cultural differences could also potentially explain the variation in the prevalence of inadequate HL, especially considering how HL was measured in this study. Participants from individualistic societies, where independence is the norm, may be more comfortable filling out medical forms by themselves compared with participants from more "group-oriented" societies.[28] Last, the HL demand (defined as the complexity and difficulty of a stimulus[29]) of the medical forms could also vary across countries, which could also play a part in the variation in the prevalence of inadequate HL.

Consistent with previous studies in other populations, education and employment status were found to be associated with HL.[30–34] In addition, country of residence was also associated with HL. Specifically, lower education level, unemployment and residing in Brazil were shown to be associated with inadequate HL. A systematic review focusing on heart failure patients showed that educational attainment was consistently positively correlated with HL.[31] Similarly, a review of HL in chronic kidney disease also found that lower educational attainment was consistently associated with inadequate HL.[32] Whereas having higher education does not guarantee adequate HL, because general literacy is a prerequisite of HL,[35] having less education has consistently been shown to be associated with lower HL.[30] Similarly, 2 studies have reported that unemployment is significantly associated with inadequate HL.[33,34] Last, we found that country of residence was associated with HL. Our data suggest that the country of residence could carry country-specific differences, such as patient-, provider- and system-level factors.[36] Unlike the rest of the countries in the BRIGHT study, secondary education is not compulsory in Brazil, potentially moderating HL proficiency.[37]

Consistent with previous research,[38,39] we found that heart transplant recipients with adequate HL were more likely to engage in sufficient physical activity compared with their counterparts. Previous studies showed that inadequate HL was associated with engagement in less physical activity.[38,39] Furthermore, another study showed

Table 3 Result of the Hierarchical Regression Analysis Examining the Relationship Between Health Literacy and Physical Activity

Variable	Odds ratio[a] (95% CI)	*P*-value
Block 1[b]		
Age	1.00 (0.99 to 1.01)	0.914
Gender		
Male	Reference group	
Female	0.43 (0.28 to 0.65)	<0.001
Race/Ethnicity		
Caucasian	Reference group	
Black	0.39 (0.15 to 1.01)	0.053
Asian	0.97 (0.31 to 3.01)	0.957
Hispanic	2.05 (0.83 to 5.07)	0.119
Other	1.46 (0.62 to 3.43)	0.388
Educational attainment		
Primary	Reference group	
Secondary	0.80 (0.44 to 1.46)	0.463
University	0.89 (0.49 to 1.63)	0.710
Employment status		
Unemployed	Reference group	
Employed	1.41 (0.98 to 2.02)	0.064
Block 2[c]		
Country		
Belgium	Reference group	
France	0.26 (0.10 to 0.67)	0.005
Germany	0.25 (0.07 to 0.83)	0.023
Italy	0.35 (0.12 to 1.00)	0.051
Spain	0.99 (0.47 to 2.09)	0.975
Switzerland	1.14 (0.43 to 3.00)	0.788
UK	1.17 (0.52 to 2.63)	0.699
Canada	0.73 (0.32 to 1.68)	0.464
USA	0.90 (0.44 to 1.82)	0.760
Brazil	0.48 (0.17 to 1.37)	0.170
Australia	0.34 (0.97 to 1.19)	0.091
Block 3[d]		
Current heart failure	0.96 (0.41 to 2.24)	0.916
Para/hemiplegia	0.73 (0.09 to 6.20)	0.773
COPD	1.48 (0.64 to 3.40)	0.357
Depressive symptoms	0.93 (0.89 to 0.98)	0.004
Block 4[e]		
Healthcare provider advice	0.84 (0.50 to 1.41)	0.511
Block 5[f]		
Health literacy	1.60 (1.09 to 2.35)	0.016

AIC, Akaike information criterion; BIC, Bayesian information criterion; LR, likelihood ratio test.

[a]Odds ratios presented are from the full model (i.e., all 5 blocks).

[b]LR: 33.60, $p < 0.001$; AIC: 1,081.21; BIC: 1,132.50.

[c]LR: 37.30, $p < 0.001$; AIC: 1,063.91; BIC: 1,166.48.

[d]LR: 11.53, $p = 0.021$; AIC: 1,060.37; BIC: 1,183.46.

[e]LR: 0.38, $p = 0.538$; AIC: 1,061.99; BIC: 1,190.21.

[f]LR: 6.05, $p = 0.014$; AIC: 1,057.95; BIC: 1,191.29.

that the HL impacts physical activity through self-efficacy.[40] We posit that having the necessary skills to comprehend the beneficial effects of physical activity could potentially empower people, thus making them more likely to engage in physical activity. Finally, Wolf and colleagues offered a possible reason why HL was not found to be associated with the other health-related behaviors (i.e., smoking, alcohol use). They posited that psychosocial factors (i.e., peer influence, social norms) may influence these behaviors more, thus nullifying any potential effect of HL.[38]

There are several limitations to our study. First, as with any secondary analysis, we were limited by the variables that were available in the primary study. For example, data on participants' income/economic status (which have been shown to be correlated with HL in other studies[25,26]) were not available. Nonetheless, the variables included in the regression models were chosen based on an HL theoretical framework[16] and findings from previous HL studies. Second, the cross-sectional design of the study precludes any causal inference; hence, caution must be taken when interpreting the findings of this study. Third, HL was measured using a single-item instrument, which is inherently less reliable than multiple-item instruments.[41] Furthermore, the multidimensionality of HL necessitates a more comprehensive HL instrument—one that measures more than just reading skills, comprehension and numeracy skills, such as the Health Literacy Questionnaire.[42] In addition, the SHLS was validated using older HL instruments (STOFHLA and REALM) as reference standards. HL experts have recently called into question the adequacy of these older instruments as "gold standards."[43] Despite the limitations, our study has significant strengths in that it used a relatively large sample of participants, which allowed for the adjustment of several potential confounders. In addition, the participants were recruited from multiple countries, thus increasing the generalizability of our findings.

Implications for clinical practice and future research

Clinicians caring for heart transplant recipients should be aware of the prevalence of inadequate HL and take precautionary measures to mitigate its negative effects. Some HL experts recommend that a universal approach should be adopted; that is, to assume that every patient has limited HL and to structure the delivery of care accordingly.[43,44] However, strategies should be tailored and targeted for individuals who are at higher risk for limited HL.[45] A useful strategy to adopt in the clinical setting is the teach-back method, wherein patients are asked to restate, in their own words, the information that has been communicated to them.[46] This strategy allows the clinician to identify any misunderstanding and lapses in recall.[46] Other communication strategies that are helpful in addressing limited HL include: using everyday language; limiting the amount of information presented to the patient to 3 to 5 key points at a time; demonstrating the task to the patient or using step-by-step instructional videos; and making sure that written materials given to the patient are appropriate for their reading level.[45]

Future studies should use a more robust measure for HL and one that measures the multiple dimensions of HL beyond simple reading comprehension. Intervention studies targeting the heart transplant population should also consider HL and its implications during the intervention design process. Furthermore, researchers engaged in HL

research need to reach a consensus on how to define and operationalize HL. Currently, the multitude of HL definitions and instruments makes the comparison of findings difficult and we are left with conflicting data the effects of HL.[47]

In conclusion, in this study we identified significant variability in the prevalence of inadequate HL across the 11 countries. Education, employment status and country of residence were found to be correlated with HL. In addition, HL was shown to be associated with physical activity. Specifically, heart transplant recipients with adequate HL were more likely to engage in sufficient physical activity compared with their less health-literate counterparts. Finally, clinicians should recognize that almost one third of heart transplant participants have inadequate health literacy. Communication strategies should be adopted that can mitigate the potential negative impact of inadequate HL.

Disclosure statement

The authors have no conflicts of interest to disclose. M.I.C. was supported by the NINR Ruth L. Kirschstein National Research Service Award (1 F31 NR015943-01). The BRIGHT study was funded by research grants from the International Transplant Nurses Society in 2008, the International Society for Heart and Lung Transplantation in 2012, the Swiss Academy of Medical Sciences (SAMW) in 2013, as well as an unrestricted research grant from Astellas Pharma. The funding organizations have no access to the data and were not involved with manuscript preparation.

Appendix

The BRIGHT study team consists of: Maria G. Crespo-Leiro (Hospital Universitario À Coruña, La Coruña, Spain); Sandra Cupples (U.S. Department of Veterans Affairs, Veterans Health Administration, Washington, DC, USA); Paolo De Simone (Azienda Ospedaliero–Universitaria Pisana, Ospedale Cisanello, Pisa, Italy); Albert Groenewoud (Astellas Pharma Europe, Ltd., UK); Christiane Kugler (Hannover Medical School, Hannover, Germany); Linda Ohler (George Washington University, Washington, DC, USA); Johan Vanhaecke (University Hospitals Leuven, Leuven, Belgium); Alain Jean Poncelet (Cliniques Universitaires Saint Luc, Brussels, Belgium); Laurent Sebbag (Hôpital Louis Pradel, Lyon, France); Magalu Michel (Hôpital Nord Laennec, Nantes, France); Andrée Bernard (Hôpital Universitaire Pitié–Salpêtrière, Paris, France); Andreas Doesch (University Hospital Heidelberg, Heidelberg, Germany); Ugolino Livi (University Hospital, Udine, Italy); Valentina Manfredini (University of Bologna, Bologna, Italy); Vicens Brossa Loidi (Hospital de Sant Pau, Barcelona, Spain); Javier Segovia (Hospital Puerta de Hierro, Madrid, Spain); Luis Amenar (Hospital Universitari i Politècnic La Fe de Valencia, Spain); Carmen Segura Saint-Gerons (Hospital Univeritario Reina Sofia, Córdoba, Spain); Paul Mohacsi (University Hospital of Bern, Bern, Switzerland); Eva Horvath (University Hospital Zurich, Zurich, Switzerland); Cheryl Riotto (Papworth Hospital, Cambridge, UK); Gareth Parry (Freeman Hospital, Newcastle, UK); Ashi Firouzi (Royal Brompton & Harefield NHS Foundation Trust, London, UK); Stella Kozuszko (Toronto General Hospital, Toronto, ON, Canada); Haissam Haddad (University of Ottawa Heart Institute, Ottawa, ON, Canada); Annemarie Kaan (St Paul's Hospital, Vancouver, BC, Canada); Grant Fisher (London Health Sciences Centre, London, ON, Canada); Tara Miller (Duke University Hospital, Durham, NC, USA); Maureen Flattery (Virginia Commonwealth University Health System, Richmond, VA, USA); Kristin Ludrosky (Cleveland Clinic, Cleveland, OH, USA); Bernice Coleman (Cedars-Sinai Medical Center, Los Angeles, CA, USA); Jacqueline Trammell (Kaiser Permanente Santa Clara Medical Center, Santa Clara, CA, USA); Katherine St. Clair and Andrew Kao (St. Luke's Hospital, Kansas City, MO, USA); Maria Molina (Hospital of the University of Pennsylvania, Philadelphia, PA, USA); Karyn Ryan Canales (Ochsner Medical Center, New Orleans, LA, USA); Samira Scalso de Almeida (Hospital Israelita Albert Einstein, São Paulo, Brazil); A. Cotait Ayoub (Instituto Dante Pazzanese de Cardiologia, São Paulo, Brazil); Fernanda Barone (Instituto do Coração da Universidade de São Paulo, São Paulo, Brazil); Michelle Harkess (St. Vincent's Hospital, Sydney, Australia); and Joanne Maddicks-Law (The Prince Charles Hospital, Brisbane, Australia).

References

1. Berkman ND, Sheridan SL, Donahue KE, et al. Low health literacy and health outcomes: an updated systematic review. Ann Intern Med 2011; 155:97-107.
2. Pleasant A, Cabe J, Patel K, et al. Health literacy research and practice: a needed paradigm shift. Health Commun 2015;30:1176-80.
3. Institute of Medicine. In: Nielsen-Bohlman L, Panzer AM, Kindig DA, editors. Health literacy: a prescription to end confusion. Washington, DC: National Academies Press; 2004.
4. Wali H., Grindrod K. Don't assume the patient understands: qualitative analysis of the challenges low health literate patients face in the pharmacy. Res Soc Adm Pharm (in press).
5. Lindquist LA, Go L, Fleisher J, et al. Relationship of health literacy to intentional and unintentional non-adherence of hospital discharge medications. J Gen Intern Med 2012;27:173-8.
6. Wallace AS, Perkhounkova Y, Bohr NL, et al. Readiness for hospital discharge, health literacy, and social living status. Clin Nurs Res (in press).
7. Henselmans I, Heijmans M, Rademakers J, et al. Participation of chronic patients in medical consultations: patients' perceived efficacy, barriers and interest in support. Health Expect 2015;18:2375-88.
8. Matsuoka S, Tsuchihashi-Makaya M, Kayane T, et al. Health literacy is independently associated with self-care behavior in patients with heart failure. Patient Educ Couns 2016;99:1026-32.
9. Kazley AS, Hund JJ, Simpson KN, et al. Health literacy and kidney transplant outcomes. Prog Transplant 2015;25:85.
10. Dageforde LA, Petersen AW, Feurer ID, et al. Health literacy of living kidney donors and kidney transplant recipients. Transplantation 2014;98:88-93.
11. Escobedo W, Weismuller P. Assessing health literacy in renal failure and kidney transplant patients. Prog Transplant 2013;23:47-54.
12. Cohen MZ, Jenkins D, Holston EC, et al. Understanding health literacy in patients receiving hematopoietic stem cell transplantation. Oncol Nurs Forum 2013;40:508-15.

13. Weng FL, Chandwani S, Kurtyka KM, et al. Prevalence and correlates of medication non-adherence among kidney transplant recipients more than 6 months post-transplant: a cross-sectional study. BMC Nephrol 2013;14:256.
14. Gordon EJ, Wolf MS. Health literacy skills of kidney transplant recipients. Prog Transplant 2009;19:25-34.
15. Grubbs V, Gregorich SE, Perez-Stable EJ, et al. Health literacy and access to kidney transplantation. Clin J Am Soc Nephrol 2009; 4:195-200.
16. Paasche-Orlow MK, Wolf MS. Literacy to health outcomes. Am J Health Behav 2007;31(suppl 1):S19-26.
17. Berben L, Denhaerynck K, Dobbels F, et al. Building research initiative group: chronic illness management and adherence in transplantation (BRIGHT) study: study protocol. J Adv Nurs 2015;71:642-54.
18. Chew LD, Griffin JM, Partin MR, et al. Validation of screening questions for limited health literacy in a large VA outpatient population. J Gen Intern Med 2008;23:561-6.
19. McNaughton C, Wallston KA, Rothman RL, et al. Short, subjective measures of numeracy and general health literacy in an adult emergency department setting. Acad Emerg Med 2011;18:1-16.
20. Marshall A, Smith B, Bauman A, et al. Reliability and validity of a brief physical activity assessment for use by family doctors. Br J Sports Med 2005;39:294-7.
21. Swiss Federal Statistics Office. Gesundheit und Gesundheitsverhalten in der Schweiz 2007: Schweizerische Gesundheitsbefragung. 2008. Available at www.bfs.admin.ch/bfs/portal/de/index/news/publikationen.Document.137644.pdf. Accessed October 12, 2016.
22. Sorensen K, Pelikan JM, Rothlin F, et al. Health literacy in Europe: comparative results of the European Health Literacy Survey (HLS-EU). Eur J Public Health 2015;25:1053-8.
23. Lupattelli A, Picinardi M, Einarson A, et al. Health literacy and its association with perception of teratogenic risks and health behavior during pregnancy. Patient Educ Couns 2014;96:171-8.
24. Renkes AC. Financial barriers to organ transplantation: a comparative analysis. SPNHA Rev 2012;8:33-42.
25. Paasche-Orlow M, Parker R, Gazmararian J, et al. The prevalence of limited health literacy. J Gen Intern Med 2005;20:175-84.
26. Heijmans M, Waverijn G, Rademakers J, et al. Functional, communicative and critical health literacy of chronic disease patients and their importance for self-management. Patient Educ Couns 2015;98:41-8.
27. Garcia VD, Abbud-Filho M, Felipe C, et al. An overview of the current status of organ donation and transplantation in Brazil. Transplantation 2015;99:1535-7.
28. Carteret M. Cultural values of latino patients and families. Available at http://www.dimensionsofculture.com/2011/03/cultural-values-of-latino-patients-and-families/. 2011. Accessed July 13, 2016.
29. Squiers L, Peinado S, Berkman N, et al. The health literacy skills framework. J Health Commun 2012;17(suppl 3):30-54.
30. Morrow D, Clark D, Tu W, et al. Correlates of health literacy in patients with chronic heart failure. Gerontologist 2006;46:669-76.
31. Cajita MI, Cajita TR, Han H-R. Health literacy and heart failure: a systematic review. J Cardiovasc Nurs 2016;31:121-30.
32. Fraser SDS, Roderick PJ, Casey M, et al. Prevalence and associations of limited health literacy in chronic kidney disease: a systematic review. Nephrol Dial Transplant 2013;28:129-37.
33. Osborn CY, Paasche-Orlow MK, Bailey SC, et al. The mechanisms linking health literacy and health status. Am J Health Behav 2011; 35:118-28.
34. Toci E, Burazeri G, Kamberi H, et al. Socio-economic correlates of functional health literacy among patients of primary health care in Kosovo. Public Health 2014;128:842-8.
35. Yamashita T, Kunkel SR. An international comparison of the association among literacy, education, and health across the United States, Canada, Switzerland, Italy, Norway, and Bermuda: implications for health disparities. J Health Commun 2015;20:406-15.
36. Havranek EP, Mujahid MS, Barr DA, et al. Social determinants of risk and outcomes for cardiovascular disease: a scientific statement from the American Heart Association. Circulation 2015;132:873-98.
37. Stanek C. The educational system of Brazil. IEM Spotlight 2013; 10:1-6.
38. Wolf MS, Gazmararian JA, Baker DW. Health literacy and health risk behaviors among older adults. Am J Prev Med 2007;32:19-24.
39. Suka M, Odajima T, Okamoto M, et al. Relationship between health literacy, health information access, health behavior, and health status in Japanese people. Patient Educ Couns 2015;98:660-8.
40. Geboers B, de Winter AF, Luten KA, et al. The association of health literacy with physical activity and nutritional behavior in older adults, and its social cognitive mediators. J Health Commun 2014;19(suppl 2): 61-76.
41. Paulhus DL, Vazire S. The self-report method. In: Robins RW, Fraley RC, Krueger RF, editors. Handbook of research methods in personality psychology. New York: Guilford Press; 2007. p. 224-39.
42. Osborne R, Batterham R, Elsworth G, et al. The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ). BMC Public Health 2013;13:658.
43. Batterham RW, Hawkins M, Collins PA, et al. Health literacy: applying current concepts to improve health services and reduce health inequalities. Public Health 2016;2016:1-10.
44. DeWalt DA, Broucksou KA, Hawk V, et al. Developing and testing the health literacy universal precautions toolkit. Nurs Outlook 2011;59: 85-94.
45. Brega A, Barnard J, Mabachi NM, et al. AHRQ health literacy universal precautions toolkit. Rockville, MD: Agency for Healthcare Research and Quality; 2015.
46. White M, Garbez R, Carroll M, et al. Is “teach-back” associated with knowledge retention and hospital readmission in hospitalized heart failure patients? J Cardiovasc Nurs 2013;28:137-46.
47. Pleasant A, Rudd RE, Leary CO, et al. Considerations for a new definition of health literacy. Washington, DC: National Academy of Medicine; 2016.